ASTRAPÉ CONSULTING
innovation in electric system planning

Duke Energy Carolinas

2020 Resource Adequacy Study

CONFIDENTIAL APPENDIX (REDACTED)

9/1/2020

PREPARED FOR

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Confidential Appendix – DEC 2020 Resource Adequacy Study

Table CA1. DEC Import Capability including TRM

DEC	Total Summer Capability (MW)	Total Winter Capability (MW)
SC to DEC	[redacted]	[redacted]
SCEG to DEC	[redacted]	[redacted]
SOCO to DEC	[redacted]	[redacted]
TVA to DEC	[redacted]	[redacted]
PJM West to DEC	[redacted]	[redacted]
Yadkin to DEC	[redacted]	[redacted]
CPLE to DEC	[redacted]	[redacted]
CPLW to DEC	[redacted]	[redacted]
Total	[redacted]	[redacted]

Table CA2. DEC Purchase Contract Modeling

Unit Name	Summer Capacity (MW)	Winter Capacity (MW)
NUG Poultry, Swine, Non-Hydro, Wholesale Non-Hydro	7	7
NUG Hydro	3	3
[redacted]	1	1
[redacted]	8	8
[redacted]	4	4
[redacted]	2	2
[redacted]	0.6	0.6
[redacted]	12	12
[redacted]	7	7

Table CA3. Fuel Prices

Fuel Type	2024 Average Delivered Price	
Uranium	[redacted]	$/MMBtu
Delivered Coal	[redacted]	$/MMBtu
Delivered Natural Gas	[redacted]	$/MMBtu
Delivered Oil	[redacted]	$/MMBtu

Table CA4. System EFOR[1]

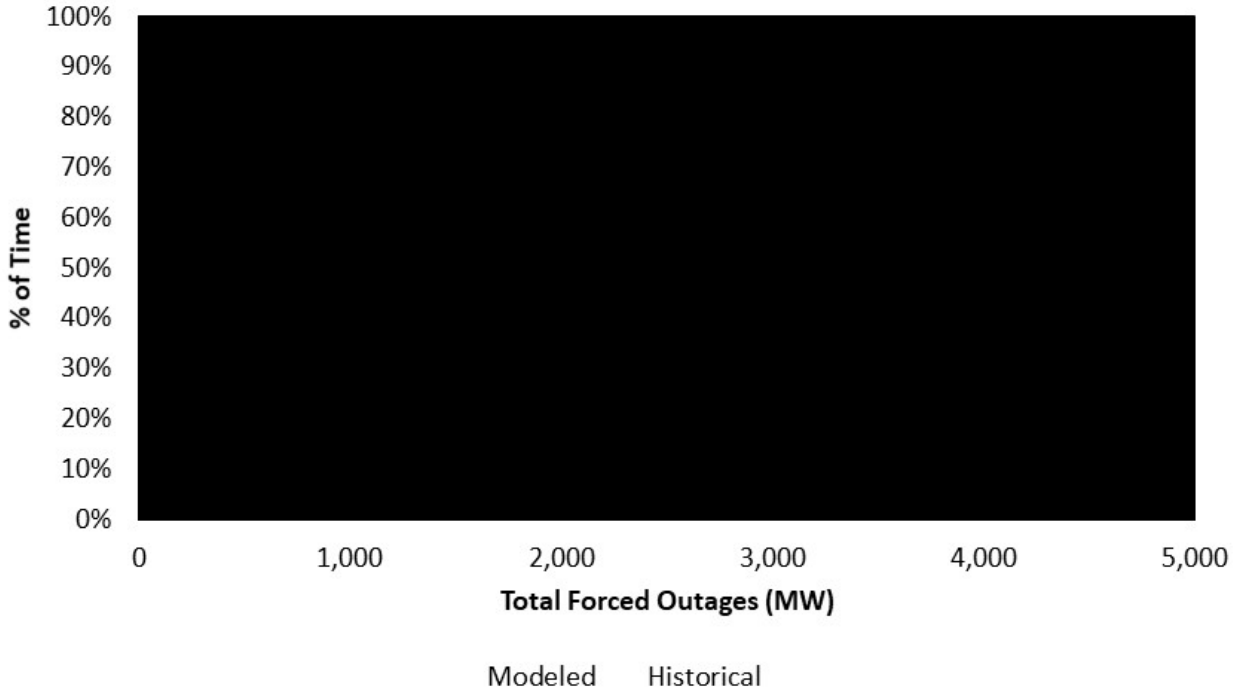
Unit Name	Resource Type	Annual EFOR	Summer EFOR	Winter EFOR
Allen 1	Coal	[redacted]	[redacted]	[redacted]
Allen 2	Coal	[redacted]	[redacted]	[redacted]
Allen 3	Coal	[redacted]	[redacted]	[redacted]
Allen 4	Coal	[redacted]	[redacted]	[redacted]
Allen 5	Coal	[redacted]	[redacted]	[redacted]
Belews Creek 1	Coal	[redacted]	[redacted]	[redacted]
Belews Creek 2	Coal	[redacted]	[redacted]	[redacted]
Cliffside 5	Coal	[redacted]	[redacted]	[redacted]
Cliffside 6	Coal	[redacted]	[redacted]	[redacted]
Marshall 1	Coal	[redacted]	[redacted]	[redacted]
Marshall 2	Coal	[redacted]	[redacted]	[redacted]
Marshall 3	Coal	[redacted]	[redacted]	[redacted]
Marshall 4	Coal	[redacted]	[redacted]	[redacted]
Catawba 1	Nuclear	[redacted]	[redacted]	[redacted]
Catawba 2	Nuclear	[redacted]	[redacted]	[redacted]
McGuire 1	Nuclear	[redacted]	[redacted]	[redacted]
McGuire 2	Nuclear	[redacted]	[redacted]	[redacted]
Oconee 1	Nuclear	[redacted]	[redacted]	[redacted]
Oconee 2	Nuclear	[redacted]	[redacted]	[redacted]
Oconee 3	Nuclear	[redacted]	[redacted]	[redacted]
Buck CC	Combined Cycle	[redacted]	[redacted]	[redacted]
Dan River CC	Combined Cycle	[redacted]	[redacted]	[redacted]
Lee CC	Combined Cycle	[redacted]	[redacted]	[redacted]
Lee NG Conversion	Natural Gas	[redacted]	[redacted]	[redacted]
Lincoln CT_1	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_2	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_3	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_4	Natural Gas Peaker	[redacted]	[redacted]	[redacted]

[1] If a unit did not have forced outage events in one of the 4 seasons (summer, winter, spring, fall) during the historical period, then the events of one season were duplicated for other seasons which explains why the annual, summer, and winter EFOR are identical for some units. CT EFOR values were capped at 15% because generators that only operated a few hours have high historical EFOR values that are not representative of future operation during years with significant high load periods. However, if the CT EFORs were not capped, the system weighted EFOR would increase to 5.5% causing an increase in 1.5% in reserve margin results. The annual EFORs were scaled to 15% so seasonable values may be lower or higher than the 15%.

Lincoln CT_5	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_6	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_7	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_8	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_9	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_10	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_11	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_12	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_13	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_14	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_15	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lincoln CT_16	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Lee CT_1	Oil Peaker	[redacted]	[redacted]	[redacted]
Lee CT_2	Oil Peaker	[redacted]	[redacted]	[redacted]
Mill_Creek_CT_1	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Mill_Creek_CT_2	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Mill_Creek_CT_3	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Mill_Creek_CT_4	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Mill_Creek_CT_5	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Mill_Creek_CT_6	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Mill_Creek_CT_7	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Mill_Creek_CT_8	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Rockingham CT_1	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Rockingham CT_2	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Rockingham CT_3	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Rockingham CT_4	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Rockingham CT_5	Natural Gas Peaker	[redacted]	[redacted]	[redacted]
Jocassee_1	Pump Storage Hydro	[redacted]	[redacted]	[redacted]
Jocassee_2	Pump Storage Hydro	[redacted]	[redacted]	[redacted]
Jocassee_3	Pump Storage Hydro	[redacted]	[redacted]	[redacted]
Jocassee_4	Pump Storage Hydro	[redacted]	[redacted]	[redacted]
Bad Creek_1	Pump Storage Hydro	[redacted]	[redacted]	[redacted]
Bad Creek_2	Pump Storage Hydro	[redacted]	[redacted]	[redacted]
Bad Creek_3	Pump Storage Hydro	[redacted]	[redacted]	[redacted]
Bad Creek_4	Pump Storage Hydro	[redacted]	[redacted]	[redacted]

Capacity Weighted Average	[redacted]	[redacted]	[redacted]

Figure CA1. Resources on Unplanned Outage as a Percentage of Time



The total MWs offline produced by the model calibrated very closely to the 2014 – 2019 historical values. Figure CA1 demonstrates that in any given hour, the DEC system can have between 0 and [redacted] MW of its thermal resources offline due to forced outages, forced derates, and maintenance outages. The figure further shows that in 10% of all hours, DEC has greater than [redacted] MW of its thermal resources in an unplanned outage condition.

Figure CA2. 2014-2019 Outage Summary Chart (Combined DEC and DEP)

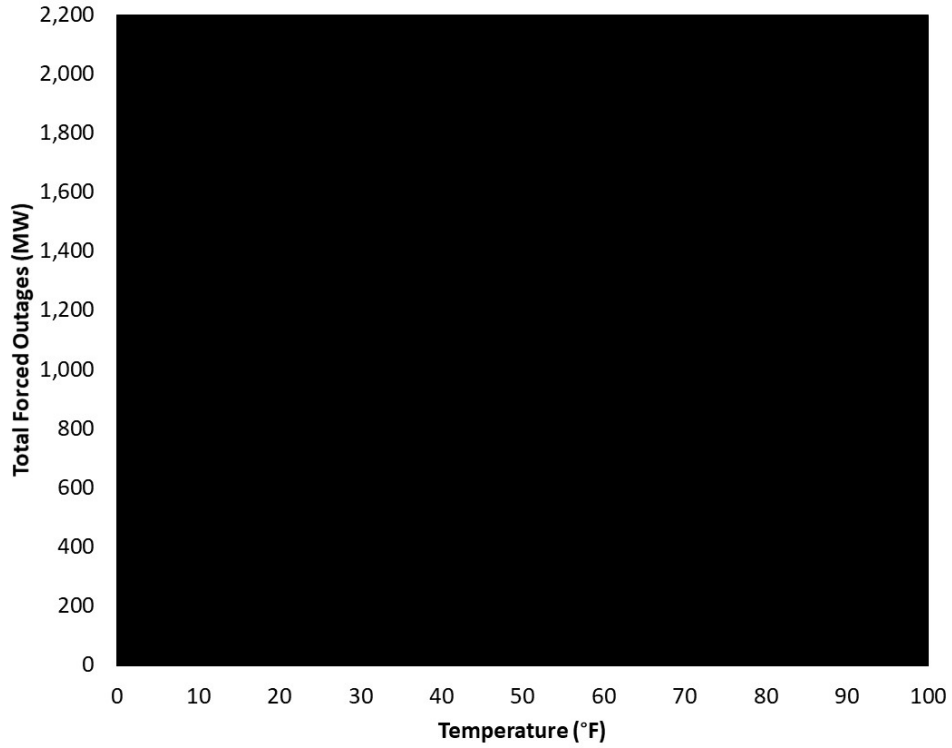


Figure CA3. 2016-2019 Outage Summary Chart (Combined DEC and DEP)

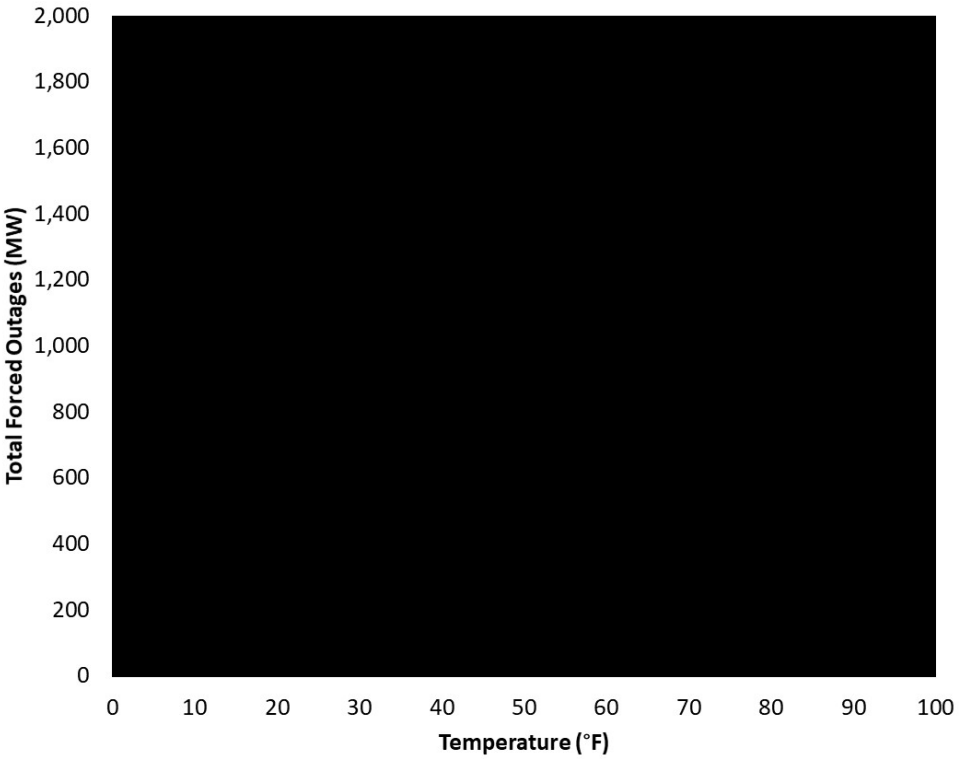


Table CA5. MWs of Outage on 10 Coldest Days Only Due to Cold Weather (Combined DEC and DEP)

	MWs of Outage Due to Cold Weather									
Hour	1/7/2014	2/20/2015	1/8/2015	1/24/2014	1/2/2018	1/6/2014	1/9/2017	1/8/2017	1/8/2014	1/1/2018
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
6	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
7	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
8	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
10	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
11	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
12	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
13	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
14	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
15	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
16	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
17	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
18	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
19	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
20	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
21	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
22	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
23	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
24	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Min Temp (°F)	6	8	9	10	10	12	15	16	16	17

Figure CA4. 2015 & 2018 Historical and Modeled Purchases

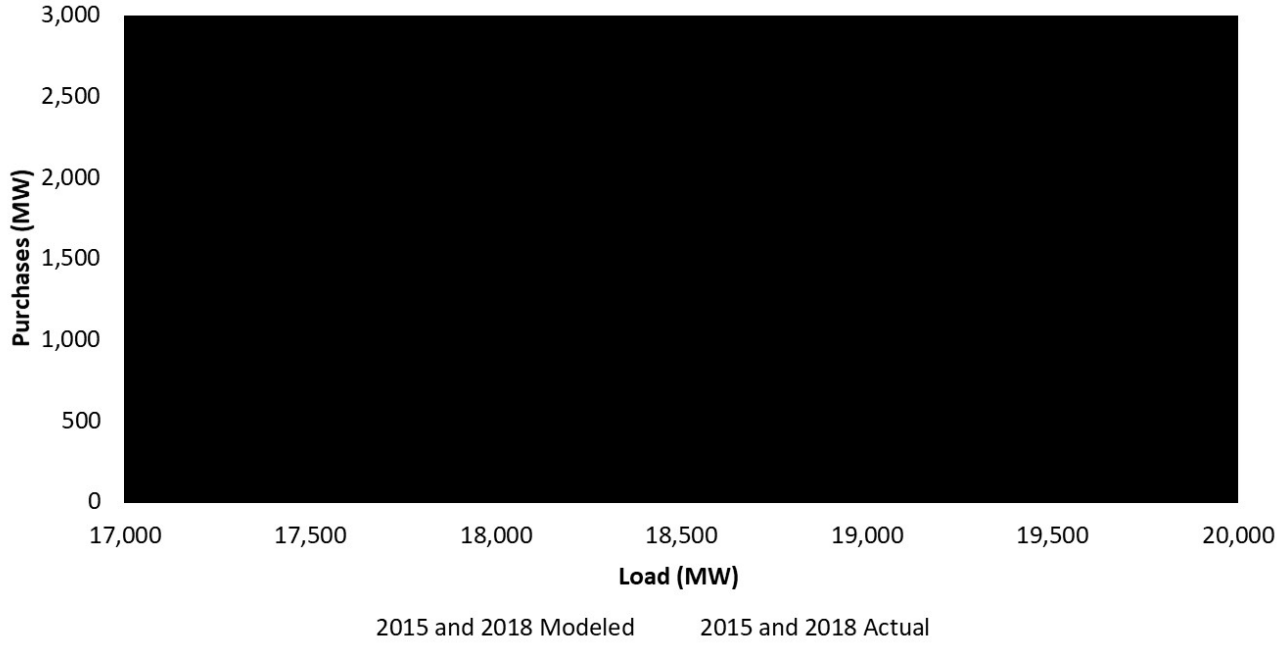


Table CA6. Economic Carrying Cost (based on Summer Rating)

Study Year	ECC Capacity Costs ($/kW-yr)	FOM ($/kW-yr)	ECC plus FOM ($/kW-yr)
2024	[redacted]	[redacted]	[redacted]